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The second part of the volume presents a detailed account of the most important families of vascular plants and their representatives, the vegetation forms, the formations, and the "biology" of the representative plants. Among the more interesting of the forest trees are the beeches (Nothofagus), of which five species are deciduous and three evergreen, and the conifers (Araucaria and Fitzroya); the latter forms swamp forests, perhaps comparable to our tamarack swamps. These conifers and beeches sometimes form pure forests, but most of the Chilean forests contain many tree species. Other important formations are the bamboo (Chusquea) thickets, xerophytic acacia thickets, and steppes.

The most detailed portion of the volume is that presenting the floristic features of the Chilean vegetation from north to south, and the delimitation of floral provinces. Many endemic species and monotypic genera are found in the country. The final chapters consider the relations of the Chilean flora to other floras (notably those of California, New Zealand, and Argentine), the life-history of the Chilean flora, and the modifications due to human influence. From the developmental standpoint the flora is made up of (1) a tropical contingent, the oldest of all, dating from the Mesozoic; (2) the Andine contingent, a xerophytic element associated with the rise of the Cordilleras; (3) the Californian and Mexican contingent; (4) the Antarctic contingent, mostly in southern Chile, and related to the New Zealand flora; (5) the boreal contingent, perhaps the most interesting of all, there being genera and even species in southern Chile that are common with the far north; (6) ubiquists and littoral pantropists; and (7) adventives. Many admirable plates add much to this important volume.—H. C. COWLES.

The pendulation theory

Now and then a geologist attempts to account for Permian glaciation within the tropics by supposing that the poles have shifted their position during the course of geologic history. Such theories are usually dismissed because they introduce more difficulties than they dispel. A few years ago PAUL REIBISCH, an engineer, laid before the *Verein für Erdkunde* at Dresden such a theory, known as the pendulation theory. There is now presented by Professor SIMROTH[2] of Leipzig a detailed account of the theory, together with a new alignment of facts of distribution. The essence of the pendulation theory is that the earth swings slowly to and fro upon an axis whose poles are in Ecuador and Sumatra. These poles are supposed to remain fixed, but the axial extremities that we commonly call the north and south poles are such for but a moment, speaking geologically. It will be seen that Ecuador and Sumatra must have been in the equatorial realm from the beginning, while for points now on the equator but 90° distant from these fixed poles (i. e. in the French Congo region and in the Pacific Ocean north of Samoa), there may have been in times past any conditions between polar and equatorial. According to this theory, past variations in climate in any given place have been due to pendulation.

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[2] SIMROTH, HEINRICH, Die Pendulationstheorie. pp. xii+564. *maps 27*. Leipzig: Konrad Grethlein's Verlag.] 1907. *M*12.

Glacial periods, such as the Permian and Pleistocene, have been developed through a poleward swing of regions now temperate; while warm periods, such as the Cretaceous and Eocene, have been developed by means of a swing toward the equator. At the present time Europe and eastern North America are supposed to be swinging southward and getting warmer, while western North America is swinging northward. Pendulation causes constant redistribution in the oceanic waters, by reason of the earth's oblateness, thus accounting for the submergence of coast lines.

The major portion of the volume is devoted to the presentation of the facts of distribution in animals as related to the pendulation theory. It is claimed that the various groups are more or less symmetrically distributed with reference to the fixed poles, owing to the control exerted on migration by the swinging of the earth on its axis of pendulation. One chapter only is given to plants, and in this chapter chief attention is paid to the conifers and Campanulaceae. Three maps are presented, showing the distribution of the conifers. In these and other maps southern Europe figures largely as a center of origin of forms and a center of migration, and the attempt is made to show that migration has taken place symmetrically from that region.

The volume as a whole has a strangely medieval atmosphere. Students of geographic distribution in these days are so accustomed to look carefully for facts that they have largely ceased to care for hypothetical disquisitions such as that of SIMROTH. One feels that the author regards the pendulation theory as a panacea, and that he selects for consideration those facts of distribution which fit it best. Certainly the problems of migration are vastly more than the symmetrical movement of organisms from a center under the control of the direction of pendulation. And the idea of pendulation itself seems more like an iridescent fancy than a reality. Biologists may well wait until there is some astronomic or geologic basis for such a hypothesis before they attempt to readjust their facts to the new theory.—H. C. COWLES.

MINOR NOTICES

Purple bacteria.—A monograph on Rhodobacteria[3] is the natural outcome of the results of shorter studies on the subject which have been presented from time to time by MOLISCH. After a discussion, partly historical, of methods of culture, the author describes eleven new species recognized by him and gives a classification, based upon those of WINOGRADSKY and MIGULA, in which he divides the order Rhodobacteria, containing all known purple bacteria, into two families: those which do and those which do not show sulphur granules in the cell substance. Turning to the biochemical side of the study, MOLISCH examines the relation of

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[3] MOLISCH, HANS, Die Purpurbacterien nach neuen Untersuchungen. pp. 95. *pls. 4.* Jena: G. Fischer. 1907.